

thereby preventing suffocation. Iodide of potassium was given as an antiplastic, also the chlorate of potash for the same end, and to correct the fetor. Huxham's tinc. bark and mar. tinc. iron were beneficial in the low and lingering cases. Chlorinated soda, a drachm to three ounces of water, is an excellent gargle. The application of nitrate of silver, solid or in solution (a drachm to the ounce), to the inflamed surface, once or twice a day, was a prominent and indispensable part of the treatment in the severe cases. Externally, the most active counter-irritants are the best applications. The merits of flies, mustard poultices, stimulating lotions, and rubefacient liniments were thoroughly tested—the same arguments urged against blistering in other throat affections apply in this. Mustard vindicates itself from these, and is decidedly a superior application; and when added to Indian meal or wheat bran poultice, can be tempered to the patient's tolerance. It alleviates the internal pain, and controls to some extent the diphtheritic exudation.

Sequelæ.—In several cases serious secondary affections came on after the throat had recovered, characterized by universal paleness of the skin, lips, tongue, and mucous surface, and extreme whiteness of the conjunctiva. The muscles were soft and flabby; the patient is feeble; has a sort of random, shuffling gait; cannot grasp and retain bodies by the hand. There is great mental depression, and disposition to sleep; constant constipation, feeble appetite, and digestion. Neuralgic pains of neck, shoulders, and body are common. In one case sight was so much impaired that large print could not be read, and the voice was nearly destroyed. The soft palate and uvula dangled in the pharynx like a dead curtain. The larynx of this person had been severely affected. All of these cases recovered under rational treatment.

ART. VII.—*On Nervous Action.* By JOHN ASHHURST, JR., M.D.,
of Philadelphia.

NERVOUS action is of two kinds—direct and reflex. Until within a comparatively recent time the nerves were supposed to receive excitation only from the mind; while the tendency now is to neglect the mind entirely, and attribute all nervous manifestations to reflexions of external impressions.

Two questions of considerable interest here present themselves, viz: 1. How many of our actions are reflex? 2. What constitutes nervous action? The first of these inquiries may be, to a certain degree, answered by experiment and observation; the second is almost entirely speculative.

The phenomena of sensibility may be in a great degree reflex in their nature, and many intellectual operations may be placed in the same category; but the same source of knowledge which informs us of our own

existence, as certainly teaches the power of volition. Every man knows he can will a thing, and no reasoning can convince him of the contrary.

Obviously an impression upon the periphery of the body, being transmitted to the nerve centres, may excite sensation, perception, an intellectual act, and perhaps what appears an exercise of the will, producing a secondary emanation, or even an apparently voluntary action; and this is all, in a certain sense, a reflex phenomenon. Given a nervous system and an excitant and the phenomena are produced. But the will can originate actions, and can modify or even arrest those which are excited from without. I do not refer to such actions as vomiting, or those which are obviously reflex, but to such as would generally be called voluntary. For instance, a person earnestly engaged in reading or writing shall be annoyed by an insect, and shall take measures to rid himself of it without consciousness of his own actions. The sensation of irritation is produced in his nerve centre; perception of the source, intellection of the means of its removal, and volition to put these means in use follow each other so rapidly as to appear coexistent. And yet is it not a reflex act?

Fortunately these nice questions, which savor more of metaphysics than of medicine, involve little that is of practical importance. Reflex action, as it is traced in various functions of the body in their physiological and pathological states, is of comparatively easy comprehension. For the accomplishment of a reflex action there are needed a nerve centre and afferent and efferent nerve fibres. An impression being made upon the peripheral surface, to which an excitor nerve is distributed, some modification, into the nature of which I shall inquire hereafter, is there produced, transmitted to the nerve centre to which the sensory nerve fibres lead, and thence by reflexion produces certain results in whatever parts are supplied with motor influence by the nerve fibres thence proceeding.

Take as an illustration the act of vomiting. It is effected by a peculiar combination of the actions of the respiratory muscles, with probably some assistance from the stomach and bowels. It may be produced in various ways: 1. An irritating emetic, as mustard, by an impression on the centripetal branches of the pneumogastric, causes a modification in the condition of the respiratory nerve centre, "probably," says Dr. Wood, "in the medulla oblongata and the neighboring parts of the encephalon;" here reflexion is brought about, and by the motor fibres thence proceeding such dispositions of the pharynx, larynx, diaphragm, abdominal muscles, &c., are induced as give rise to the phenomena of vomiting. 2. Substances in any way introduced into the system, by entering the blood and directly coming in contact with the nerve centre, may produce the same result; in this case, so far as concerns the nervous system, more properly by radiation than reflexion. 3. Tickling the fancies by reflex action produces vomiting. 4. Disease of the brain, and even certain ideas and emotions, are sufficient to produce the same result.

It is customary to say that reflex actions are produced independently of volition, and in some cases even of consciousness; and it is obvious that such is the case in respiration, deglutition, defecation, vomiting, &c., which are all reflex actions. But no strict line of definition can be drawn between those acts which are and those which are not of a reflex nature; Kirkes includes the so-called involuntary shrinking of a part when a blow is aimed at it among reflex actions; others call the acts of walking, &c., reflex, and in some cases they certainly appear so. I have in walking along a crowded street been met by no intimate friend, who, without recognizing me or being conscious of my presence, has stepped to one side to allow me to pass; thus adapting means to avoid a collision without consciousness apparently, and, as it were, involuntarily; yet this could hardly be called a reflex action, in the ordinary sense of the term. No limit, it would appear, can therefore be with justice assigned as distinguishing reflex from other actions.

Three kinds of nervous reflexion are admitted by Dr. Carpenter, viz: 1, excitomotor; 2, sensori-motor; and 3, emotional and ideomotor reflexion. The first finds its centre in the spinal cord, and its phenomena are chiefly manifested when the communication with the parts nearer the brain is interrupted by division or disease, though when the mind is closely engaged upon any subject, or during sleep, such excitomotor reflex acts may be manifested.

Sensori-motor reflexion has its nerve centre in the so-called sensory ganglia, including the medulla oblongata, corpora striata, thalami optici, &c. Under this division would be found the instance referred to immediately above, sensation producing the ordinary results of an intellectual act without the intervention of such intellectual operation. So with all the secondarily automatic acts of Dr. Carpenter. Here it will be perceived the same result may be produced with or without the co-operation of the intellect. But actions of a still more complex nature present many claims to be included as phenomena of reflexion. The intellect itself may be involved by the automatic action of the cerebrum. Illustrations of this are found in dreaming and somnambulism. Many instances are authenticated in which, while dreaming, external circumstances have modified the course of the dream, and caused actions such as would have caused had consciousness and volition been present. A somewhat similar case is that so often quoted of the criminal who died of fright by the simple flowing of tepid water over his limb, accompanied by the suitable remarks of the attendants; the syncope was as complete as if resulting from actual loss of blood. A similar instance is recorded by Professor Bennett: "A butcher was brought into the shop of Mr. MacFarlane, the druggist, from the market place opposite, labouring under a terrible accident. The man on trying to hook up a heavy piece of meat above his head slipped, and the sharp hook penetrated his arm so that he himself was suspended. On being examined he was pale, almost pulseless, and expressed himself as suffering acute agony. The arm

could not be moved without causing excessive pain, and in cutting off the sleeve he frequently cried out; yet when the arm was exposed it was found to be quite uninjured, the hook having only traversed the sleeve of his coat." Here we have reflex motion, reflex sensibility, intellectual activity, and what might almost be called reflex volition.

Many familiar occurrences come under the same head; the suggestion of a caterpillar to a sensitive person will cause him to feel the inroads of several of those creatures as distinctly as if they were actually present.

So the automatic expression of an idea which is present in the mind, by a person's own free will or by the suggestion of another, will give rise to actions which can hardly be believed to be, but which are undoubtedly involuntary. Such are the phenomena of the "divining rod," which can be explained by the "expectant attention" of Dr. Carpenter much more rationally than by supposing a new "odyle" force in nature. Such, too, are the phenomena of table-turning, spiritism, and mesmerism, all of which are the results of "anæsthetic cerebralization," causing acts and words which impose not only on the spectator, but frequently upon the medium himself.

Seeing, therefore, the great number of apparently spontaneous and voluntary acts which are produced really without either consciousness or volition, it is not surprising that some should have jumped by analogy to the conclusion that man was a mere machine, acted upon by and responding to external influences, without power of resistance, and, therefore, without accountability for the results. And such appears to be the case, to a certain extent, with savages and infants. But let us beware of that "falling heap" argument, impossible to refute, and yet obviously fallacious. At what age or with what degree of education and refinement free agency, and, therefore, moral responsibility begin, it is impossible to say; but consciousness, the greatest, because the earliest instructor of human nature, declines to each one of us, in such a manner as is incontrovertible, that to be what we are implies necessarily to be capable of volition.

Reflex action is effective not only in these animal functions of the economy, but its operation may be traced in the organic processes also; for instance, in nutrition and secretion. The influence of reflex action on the calibre of the bloodvessels, and the consequent degree of animal heat, was shown by some very interesting experiments of MM. Tholozan and Brown-Séquard, made some years since, and republished in the *Latter's* journal for July, 1858. The result referred to is expressed in these words: "*Que l'abaissement de la température d'un main peut amener un abaissement considérable de la température de l'autre main, sans que la température générale du corps diminue sensiblement.*" By the process of exclusion they show that this diminution of temperature must be due to the smaller calibre of the vessels, and that this is evidently caused by the reflex influence of the spinal column. In this connection the experiments of Bernard may be referred to, showing the influence of the cerebro-spinal system in increas-

ing the vascularity of glands, causing the secretion to be increased, and the venous blood coming from the gland to assume an arterial hue (*couleur rutilante*), and even to flow by jets (*un jet saccadé, isochrone au pouls*), while precisely contrary results were shown to be due to the sympathetic system.—*Brown-Séquard's Journal*, vol. i. pp. 240, 241.

It is, I believe, in the application of these results to the subject of inflammation that we are to look for the perfection of our theories of that process.

Not only is reflex action manifested in the normal condition of the body, but in many pathological states its phenomena are shown in what have been called the sympathies (the first correct views of which were, I believe, promulgated by Prof. Samuel Jackson, of the University of Pennsylvania, in his work on the "*Principles of Medicine*," published in 1832). This term "sympathy" has often been applied in a very vague manner, being used as a last resort when other modes of explanation have failed. What constitute in a diseased state sympathies, in health are hardly recognized, but, nevertheless, exist; synergy being in a normal what sympathy is in an abnormal condition. The stomach is rich in sympathies with other parts of the body, while the ever-varying sympathetic irritations dependent on uterine affections are almost proverbial.

In a therapeutical point of view reflex action is interesting, as indicating the *modus operandi* of certain medicines. Thus, it is believed by Dr. Carpenter that ergot, caustarides, aloes, and some others produce their several effects by stimulating the spinal cord to unusual sensitiveness to accustomed influences. Conversely opium, by obtunding the sensorium, prevents the action of the most powerful emetics.

The higher kinds of reflex action (the sensori-motor and ideo-motor of Dr. Carpenter) are brought out especially in certain abnormal states which may arise spontaneously, or by artificial induction. Of the former are various forms of delirium and mania; of the latter the states brought on by narcotic medicines, especially opium and the *cannabis indica*. With regard to the effects of opium we have reliable information in the well-known work of Dequaine; the "*hasheesh eater*" unfortunately excites disbelief by his marvellous anecdotes—disbelief which was not diminished by the long-time anonymous character of his publication.

It will be remembered that a second question was referred to as of interest in this connection, to wit: "In what way is nervous influence transmitted?" It was said that a certain modification in the condition of a nerve or nerve centre was brought about, which being transmitted produced such and such results. In what does this modification consist? In other words, what is nerve force? A favourite illustration, but which will hardly serve as an explanation, is that of the magnetic telegraph, with its wires and stations; and the compliment has been returned by our great American humorist, who has called the Atlantic telegraph cable the "*great par vagum*" of the world. Electricity, however, is but a name, conveying no very definite idea

as to the true nature of the force. It is probably (undoubtedly to my own mind), as are the other "physical forces," a form of motion, consisting of vibrations or, more properly, undulations, *i. e.* propagated vibrations.

Whether the hypothetical, all-pervading substance "ether" has a real existence, or whether the undulations of light, heat, sound, &c., are propagated by the various substances which surround us, I will not stop to inquire. I am inclined to think that the phenomena of optics could be explained without supposing such a fluid to exist. Be this as it may, I believe that in whatever manner the undulations of light, and sound, and heat take place (each having some substances specially adapted for taking on its peculiar vibrations), so do the undulations of electricity, and so do the undulations of nerve force take place.

It may not be uninteresting to trace the history of this hypothesis, for it can hardly as yet be called a theory. The idea that nerve force consisted in undulations was hinted at as possible by Le Gros Clark, in the *Encyclopedia Metropolitana*; and such an idea, though not fully developed, appears to have been entertained by Prof. Samuel Jackson, of the University of Pennsylvania, as early as 1837. In a published introductory lecture of 1851, he says: "Nervous force is correlative with heat and electricity, though not identical;" and the identity of the physical forces has been taught by him for over twenty years.

As has been before observed, the nature of the case prevents the demonstration of any hypothesis on this subject, as either true or certainly false; but some analogies may be indicated, and some reasons adduced why such a view has been adopted.

That sound was the result of undulations seems never to have been doubted, so manifestly coincident are its impulses with the seen vibrations of a sonorous body; and hence it is in the science of acoustics that those beautiful laws of undulation have been especially developed. Light is now generally conceded to arise from the same source. Heat is also believed to be produced by undulations; and these are all correlative and interchangeable.

The vibrations of sound are the same in nature, but more slow than those of heat; and it is probable that could vibrations be made to succeed each other with sufficient rapidity, light also might thus be artificially produced. Chemical action again probably has its source in still more rapid vibrations.

Now it seems to me more rational to suppose that the undulations of light are taken on by the optic nerve, or by the ether or phlogene (if its existence be supposed) therein contained, and thus transmitted to the ganglia belonging to that special sense; and that the undulations of sound are taken on by the auditory nerve, or the ether therein contained, and transmitted as before; this, I say, seems to me to be more rational than to suppose some mysterious nervous fluid, or something still more mysterious, without name, to be set in motion, and thus bring about the subse-

quent results. The sense of smell I imagine to be explicable in the same way. In man this sense is in an almost rudimentary condition, and consequently not often excited, but by actual contact with the Schneiderian membrane, of odorous particles or fumes. Yet a piece of musk shall be exposed for years without losing appreciably in weight, and I doubt not that the function of olfaction may be excited by undulations alone. So with the other special senses, and by analogy with what is called common sensibility, though this may be regarded as merely a modification of the sense of touch.

A further evidence for this hypothesis is that whatever excites a nerve of special sense produces in it its special phenomenon; thus, irritation of the optic nerve causes only the sensation of light, while the auditory nerve can take on only the undulations of sound.

If then, as far as we can observe nervous action in its relation with the external world, undulation appears to be the *modus agendi*, the inference is allowable that all nervous action is referable to the same process. And it would appear that without regard to the mind (which is *sui generis*, and as to its nature entirely beyond our ken) nerve force presents analogies which entitle it to a place among the physical forces. It appears to be correlative with them, i. e. can be "mediately or immediately" transformed into them, or produced from them. The sensations of light, heat, sound, &c., may originate subjectively. In the contraction of muscular fibre both heat and sound are produced, motion being intermediate. Electricity again is correlative with taste and smell, sight, hearing, and general sensibility. The increased heat of fever is probably due in a great degree to the morbid nervous action, while here is also one source of the maintenance of the animal temperature.

The "physical forces" arise from without; nerve force finds an excitant also in the inner world—the will and the soul.

ART. VIII.—*Case of Oblique Fracture of the Femur treated by the use of Adhesive Plaster, as a means of producing Extension and Counter-Extension.* By J. F. HUBER, M. D., Lancaster, Pa.

On Monday, January 9, 1860, J. E., aged fifty-nine years, was wheeling his scissor-sharpening apparatus on the icy pavement, when he fell; the shaft of his wheelbarrow struck him with great force on his right thigh. He was carried to his home, a distance of four squares. One hour after the accident had occurred I saw him, and discovered an oblique fracture of the femur about the junction of the middle with the inferior third, shortening the limb nearly one inch and a half.

Periostitis of a syphilitic character existed in the leg, and his body was covered with secondary syphilitic eruptions. I consented very reluctantly